



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY  
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OFFICE OF  
PREVENTION, PESTICIDES AND  
TOXIC SUBSTANCES

**MEMORANDUM**

**SUBJECT:** Evaluation of the Ability of Sulfuryl Fluoride (ProFume™) to Replace Methyl Bromide in Post-Harvest Uses

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**SUMMARY**

This analysis was conducted in support of the Office of Air and Radiation's (OAR) proposed rulemaking for allocation of methyl bromide for critical uses. In the proposed rule for the 2006 allocation of methyl bromide post-harvest critical use exemptions, the Agency has proposed a 15% reduction of methyl bromide in the post-harvest sector due to the registration of sulfuryl fluoride for some of these uses. The facilities included in these uses are rice mills, flour mills, food processing facilities, and pet food facilities. Dow AgroSciences, the sulfuryl fluoride registrant, submitted data and comments in response to the proposed rule which they believe support a reduction in the amount of new production of methyl bromide allocated in 2006.

The 15% reduction of methyl bromide for the post-harvest uses proposed in the 2006 allocation rule is reasonable based on broader registration on use sites and commodities for ProFume™, more state registrations, and efficacy and economic data for sulfuryl fluoride.

## BIOLOGICAL CONSIDERATIONS

In January 2004, USEPA registered sulfuryl fluoride (ProFume™) as an alternative to methyl bromide for use in structures and mills of cereal grains, dried fruit and tree nuts. In May of 2005, the State of California also registered sulfuryl fluoride for these uses. In July 2005, USEPA expanded the sulfuryl fluoride label by increasing sites to include food processing facilities and more commodities. New York was the last state to register this product in December 2005.

Sulfuryl fluoride is unique in that it allows for “precision fumigation.” The concentration of Profume™ is adjusted by a computer program, the Profume™ Fumiguide. Major aspects determine the concentration of sulfuryl fluoride needed for fumigation. They are:

1. Pests
2. Level of control (i.e. post-embryonic or all life stages, including eggs)
3. Temperature (requires higher gas concentration as temperature decreases)
4. Time of Exposure (if a miller wants to decrease time, the concentration can be increased to accomplish this)
5. Half-life of fumigant

Studies available to the Agency (submitted by Dow AgroSciences in addition to published literature) demonstrate that at warm temperatures, sulfuryl fluoride is as efficacious on stored product pests as methyl bromide. These data are from laboratory bioassays and field studies using containers and traps. Containers with a known number of target pests of different life stages are often set out during fumigations and mortality is recorded after fumigation. Various traps are set out in facilities to help monitor adult insect pest populations. Trap catch data can infer kill of larvae and pupae based on the number of days or weeks no adults are trapped, given that if the pupae or larvae had survived the fumigation they would become adults within a few days.

Published literature reports at lower temperatures a greater concentration of sulfuryl fluoride is necessary to kill eggs of the stored product insect pests. This is supported by the ProFume™ Fumiguide. If control of all life stages is selected a higher concentration of sulfuryl fluoride or increased time of exposure is required than if only post-embryonic stages is selected. In addition, as temperature decreases, a higher concentration of sulfuryl fluoride is necessary to kill eggs.

Historically, the food processing industry’s pest management culture is in the practice of targeting all life stages of any pest, with their focus on eliminating the eggs, which is the point source of a new infestation. Dow AgroSciences is proposing to target only the post-embryonic stages of these pests which would in turn leave the eggs.

Many of the studies available to the Agency do not always provide the concentration of the fumigant, the amount of exposure time, or the temperatures at which the fumigations took place. Some studies do not compare sulfuryl fluoride with methyl bromide. This increases the uncertainty of this analysis.

## USE CONSTRAINTS

The facilities included in this analysis are rice mills, flour mills, food processing facilities, and pet food facilities. The Profume™ label states that all these facilities can be fumigated with sulfuryl fluoride. If the product is not listed on the label as a commodity that can be directly (intentionally) fumigated, only incidental fumigation is allowed. Incidental fumigation has been defined by the Agency as “fumigation of negligible amounts of a commodity due to their presence in a different targeted use site.”<sup>1</sup> The intent is to allow small amounts, or traces, of processed foods that inhabit the equipment to be fumigated as a result of space fumigation. It is understood that food items are removed from the premises during fumigation. “In these instances the label would require all finished product and the majority of the facility’s bagged ingredients to be removed from the premises.”<sup>1</sup> Many food processing facilities occupy one big room and therefore do not have the space to separate products and ingredients from the processing equipment portions of the plant.

Pet food is considered a processed food, and is not listed in the commodities list on the Profume™ label. Cake mixes and other processed foods, such as cookies, pasta, etc. will also face these constraints, i.e. they can only receive incidental fumigation. However, of the facilities that process food, only the Pet Food Institute has included product in their methyl bromide CUE application. About 30-40% of these facilities are not able to separate products and ingredients from the equipment during space fumigation.

## COST ANALYSIS

The following describes the costs of sulfuryl fluoride use in structural fumigation in mills, pet food processing facilities, and food processing facilities based on the above biological considerations.

The cost of structural fumigation with sulfuryl fluoride is highly variable. Total fumigation costs accrue from the cost of the fumigant, labor, equipment used in the fumigation process, and facility downtime. Costs vary by temperature and targeted control level. The Agency lacks these data for the submitted studies. This analysis relies on potential fumigation practices, which increases the uncertainty of the estimates.

Limitations of the analysis include but are not limited to: 1) limited data available to the Agency covering the cost of fumigant application and the cost of fumigant product 2) costs of facility heating were not available, which could be used to offset the high use rates of sulfuryl fluoride in the all pest life stage control scenarios 3) only limited efficacy data are available for sulfuryl fluoride.

Given the limited data submitted to the Agency, an analysis was conducted based on the following assumptions:

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<sup>1</sup> Hazen, Susan B., Letter to Pet Food Institute dated November 8, 2005.

1. Fumigation time for both methyl bromide and sulfuryl fluoride is assumed to be 1 day for preparation, 1 day for fumigation, and 1 day for off-gassing.
2. Efficacy of methyl bromide and sulfuryl fluoride are similar within the range of normal fumigation temperatures at the post-embryonic stage, but the quantity of sulfuryl fluoride required is significantly higher when controlling all life stages, especially at lower temperatures
3. The cost of sulfuryl fluoride is higher at lower temperatures due to higher application rates. These costs can be offset by heating the structure. However, we do not have data covering heating costs.
4. Labor and equipment costs are assumed to be the same for structural fumigation with methyl bromide and sulfuryl fluoride.

## RESULTS OF THE COST ANALYSIS

The results of the cost analysis show that sulfuryl fluoride structural fumigation costs are comparable to methyl bromide at all covered temperatures (85, 80, and 75 degrees Fahrenheit) when targeting post-embryonic pest life stages. Therefore, use of sulfuryl fluoride is feasible in those instances.

When targeting pests in all life stages, sulfuryl fluoride costs are greater than methyl bromide and vary by temperature level. At 85 degrees Fahrenheit sulfuryl fluoride is 37% more expensive, at 80 degrees Fahrenheit sulfuryl fluoride is 68% more expensive, and at 75 degrees Fahrenheit sulfuryl fluoride is 94% more expensive (shown in Table 1). We do not have data representing sulfuryl fluoride application rates at lower than 75 degrees Fahrenheit.

The adoption of sulfuryl fluoride may not be feasible for certain facilities due to their low profit margins. Flour and rice mills, which make up about 80% of fumigated facilities, have 2001 net profit margins of 1.3% (flour mills) and 3.1% (rice mills).

Table 1, Cost per 1,000 cubic feet of structural fumigation

Temperature	Post-Embryonic Control			Control at all Life Stages		
	Methyl Bromide	Sulfuryl Fluoride	Percent Difference	Methyl Bromide	Sulfuryl Fluoride	Percent Difference
85 degrees Fahrenheit	\$29.42	\$30.54	3%	\$29.42	\$40.23	37%
80 degrees Fahrenheit	\$29.42	\$30.94	5%	\$29.42	\$49.51	68%
75 degrees Fahrenheit	\$29.42	\$31.35	7%	\$29.42	\$57.19	94%

Source: Data are from comments submitted to the Agency on the proposed methyl bromide allocation rule.

- Notes:
1. Based on a 12 hour fumigation with sulfuryl fluoride.
  2. Target pests in structural fumigation are primarily beetles.
  3. Calculations were made using fumigant costs based on wholesale prices.
  4. Calculations are based on 2 fumigations per year.

## **CONCLUSIONS**

Sulfuryl fluoride is in some cases a feasible alternative to methyl bromide but in other cases may not be due to efficacy, regulatory, and cost considerations. Based on the above analysis, which was conducted using information from public comment for the proposed methyl bromide allocation rule and Critical Use Exemption (CUE) applications, the Agency can reasonably support the 15% reduction of methyl bromide for the post-harvest uses proposed in the 2006 allocation rule.

## **REFERENCE:**

2004 CUE Application;

The Risk Management Association's Annual Statement Studies 2001-2002.

Public Comments on the Proposed Methyl Bromide Allocation Rule.